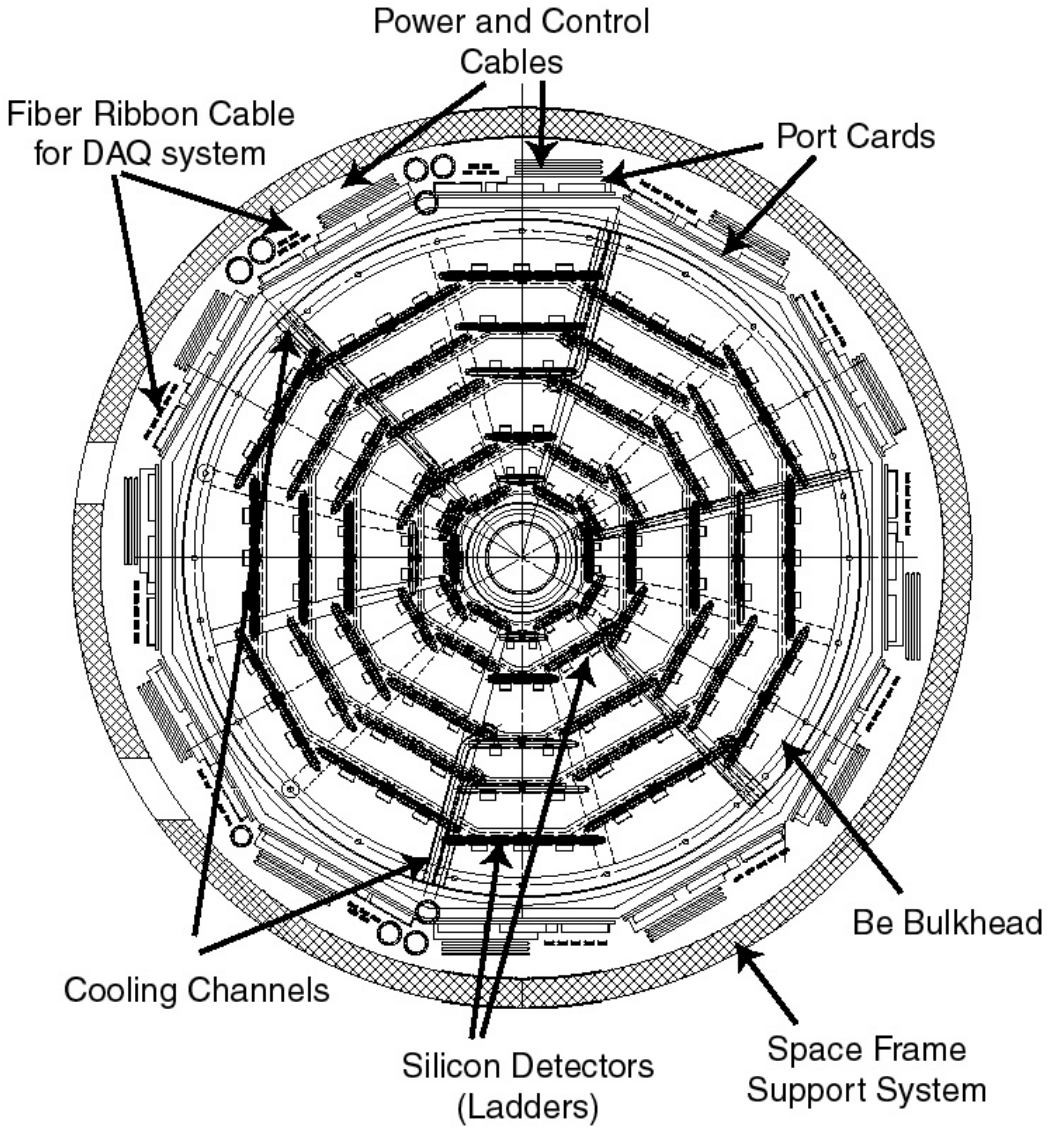
Silicon strip detector upgrade (SVX II)

Fabrication of the SVX-II detector

Doug Benjamin

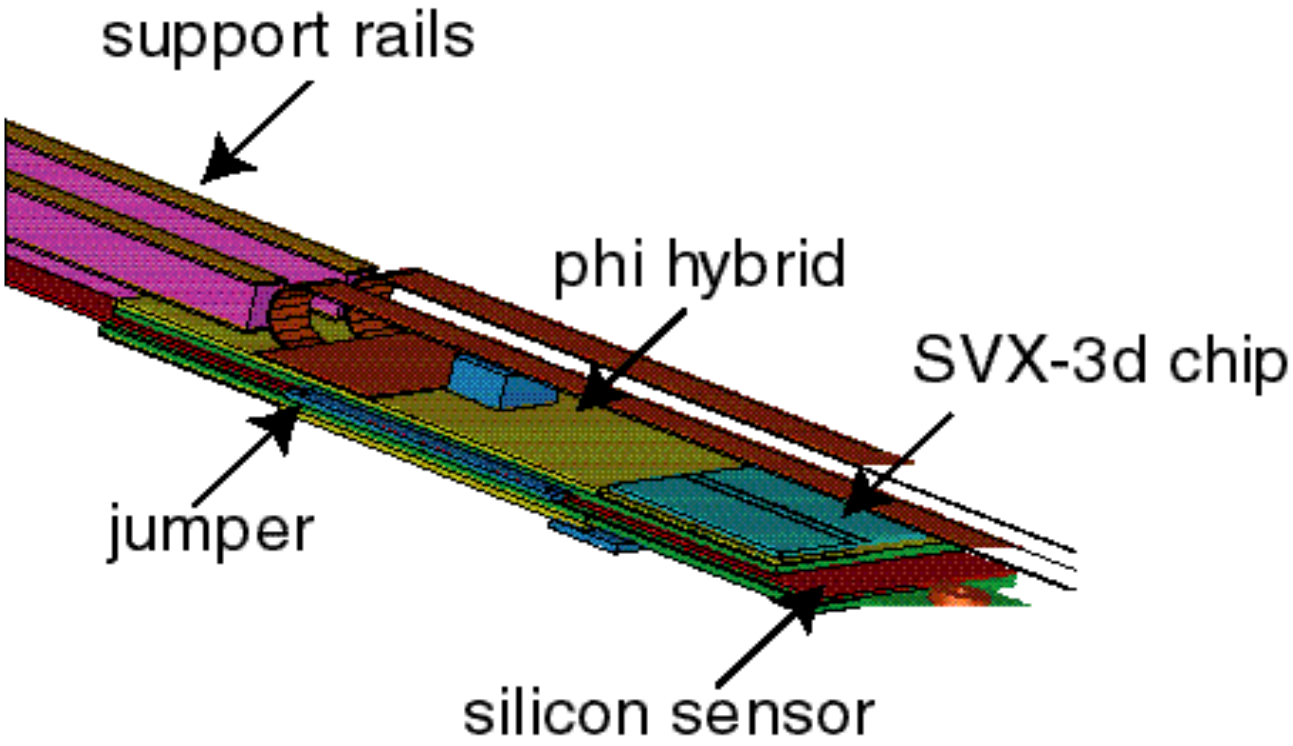
SVX II detector description

End view of SVX II barrel (3 barrels in detector)



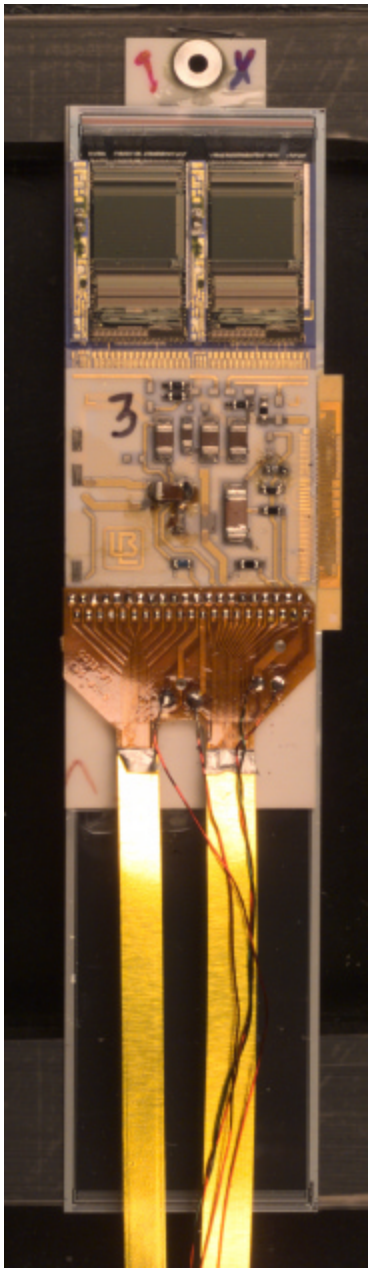
SVX-II Ladders

- Duke task: Ladder construction



- Needed to build **180** ladders (excluding spares)
- 36 of each layer
- 5 layers

R-phi side of a completed Quarter ladder



Alignment piece

Readout chips

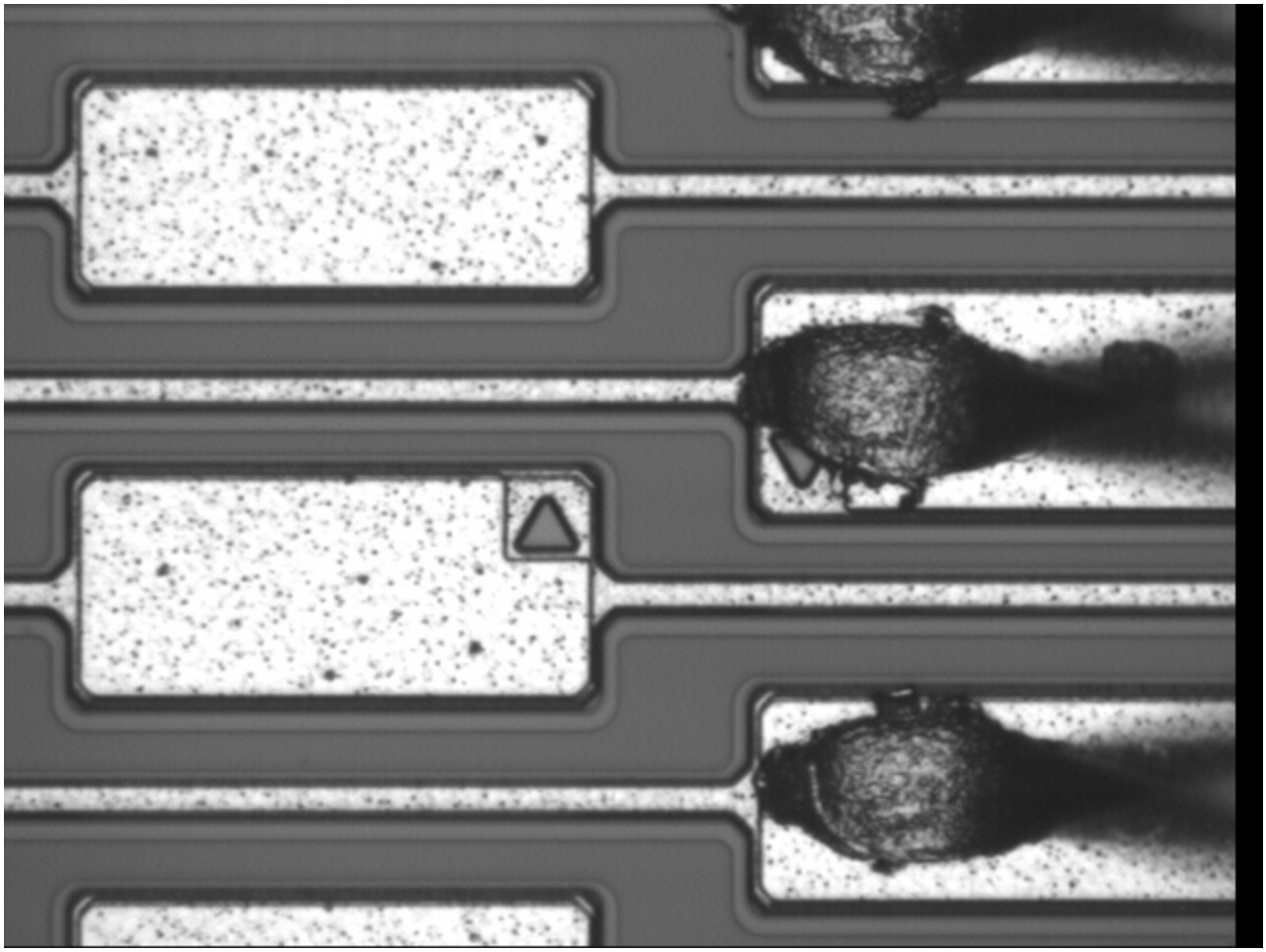
Jumper

(interconection btwn r-phi & z sides)

Silicon sensor

- 1st time can readout silicon sensor

Close up of wire bond pad and foot

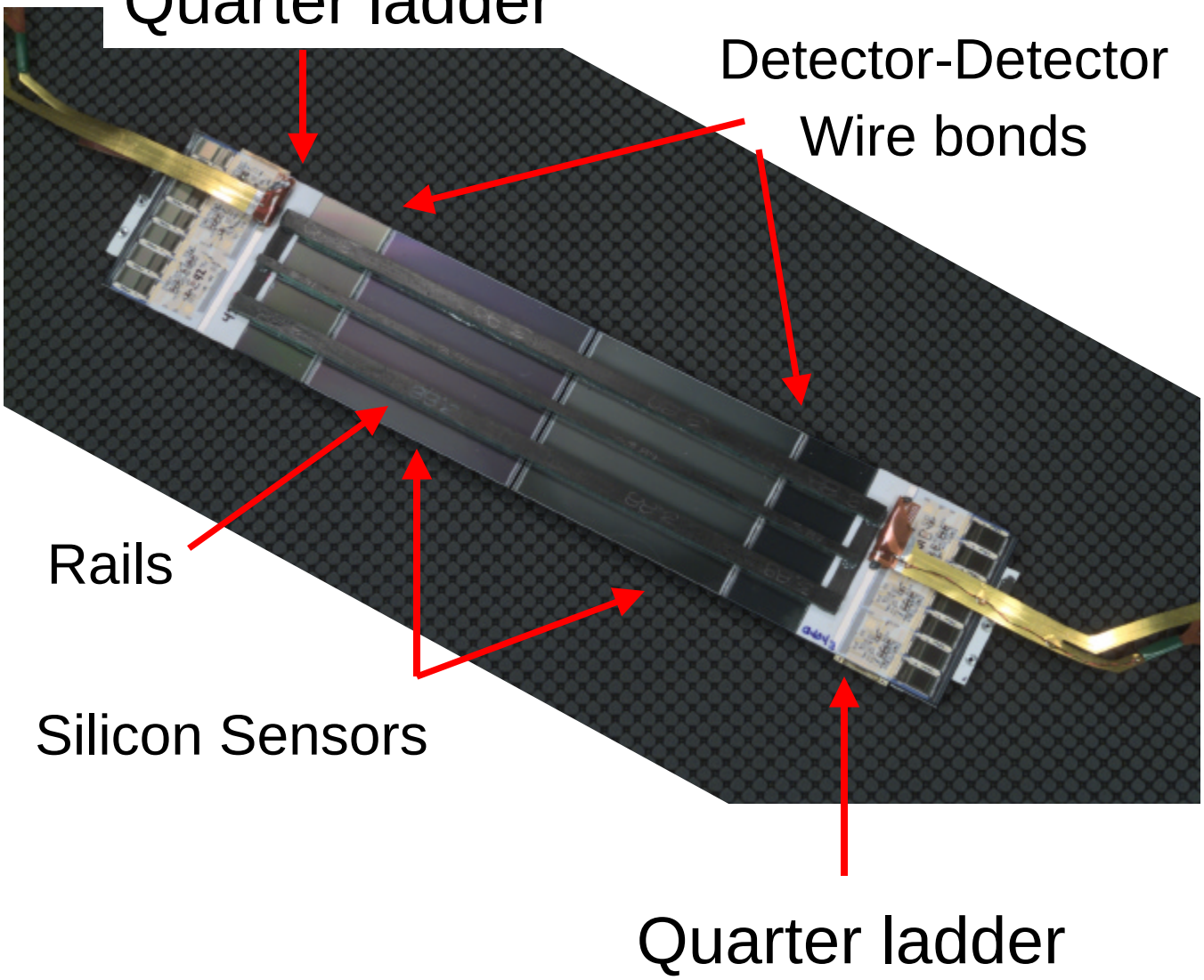


Strip pitch - 66 μm

Fiducial mark (triangle)

- 15 μm (each side)

R-phi side layer 4 prototype ladder



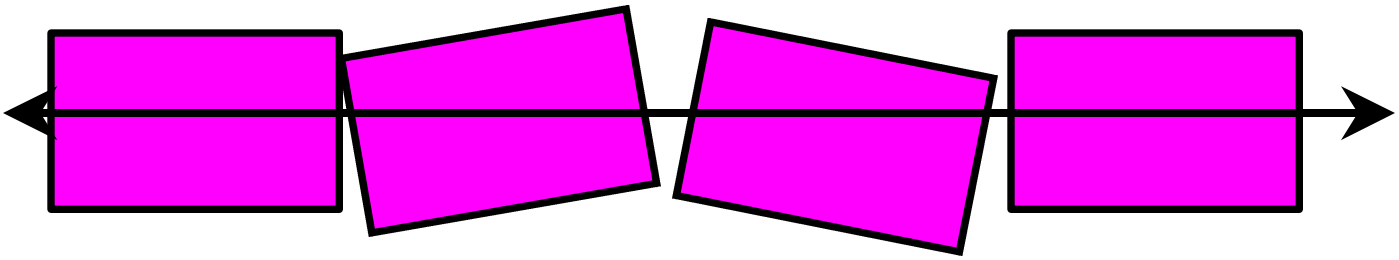
SVX II Ladder Construction

- Doug Benjamin led the ladder production effort
  - Supervised technicians building ladders
  - worked w/ designers and engineers to design and build the production fixturing
  - had the *Ultimate responsibility* for the quality of the ladders
- Construction was done primarily done at FNAL's Silicon Detector Center.
  - 23 layer 3 quarter ladders were built in Japan (28% of all L3 QL built)
  - last May traveled to Japan to review and certify quarter ladder assembly at Hamamatsu Photonics
  - Provided the final training of our Japanese colleagues in ladder testing
- Built *most (94 %)* of the quarter ladders and *all* full ladders at FNAL

SVX-II Assembly Sequence

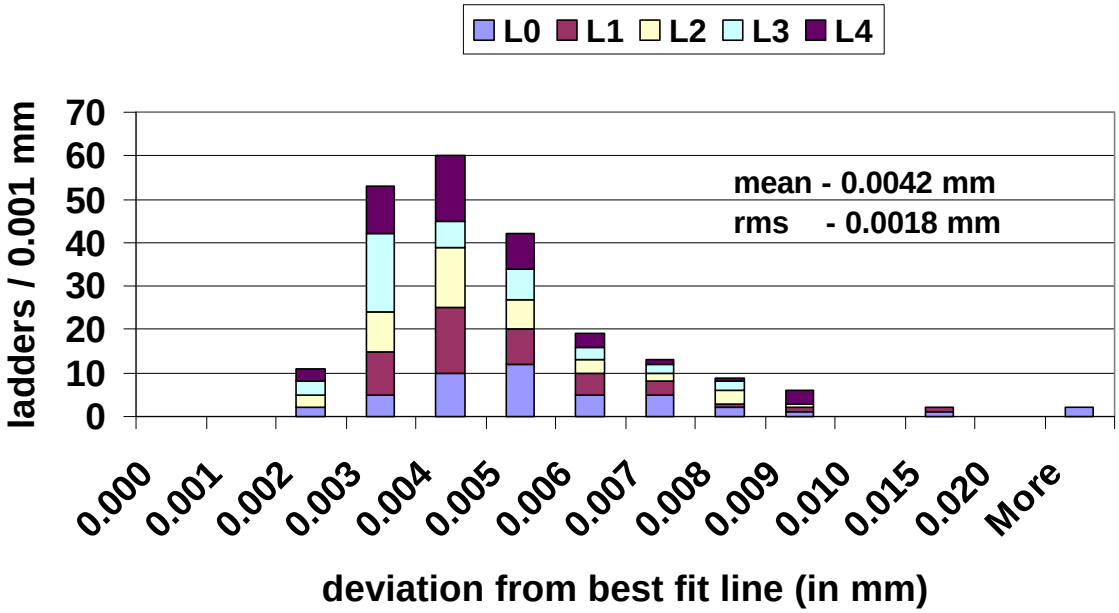
- Build quarter ladders (1 silicon sensor)
- Test quarter ladders
- Assemble pieces for full ladders
  - 2 quarter ladders (one at each end)
  - 2 intermediate pieces of silicon
- Align the 4 pieces of silicon to each other
- Test full ladder
- Store till barrel assembly

Full ladder silicon alignment



SVX-II must be parallel to beam line to within
100 μrad é sensor alignment spec. of ± 8μm

Maximum deviation from a straight line for all SVX-II ladders

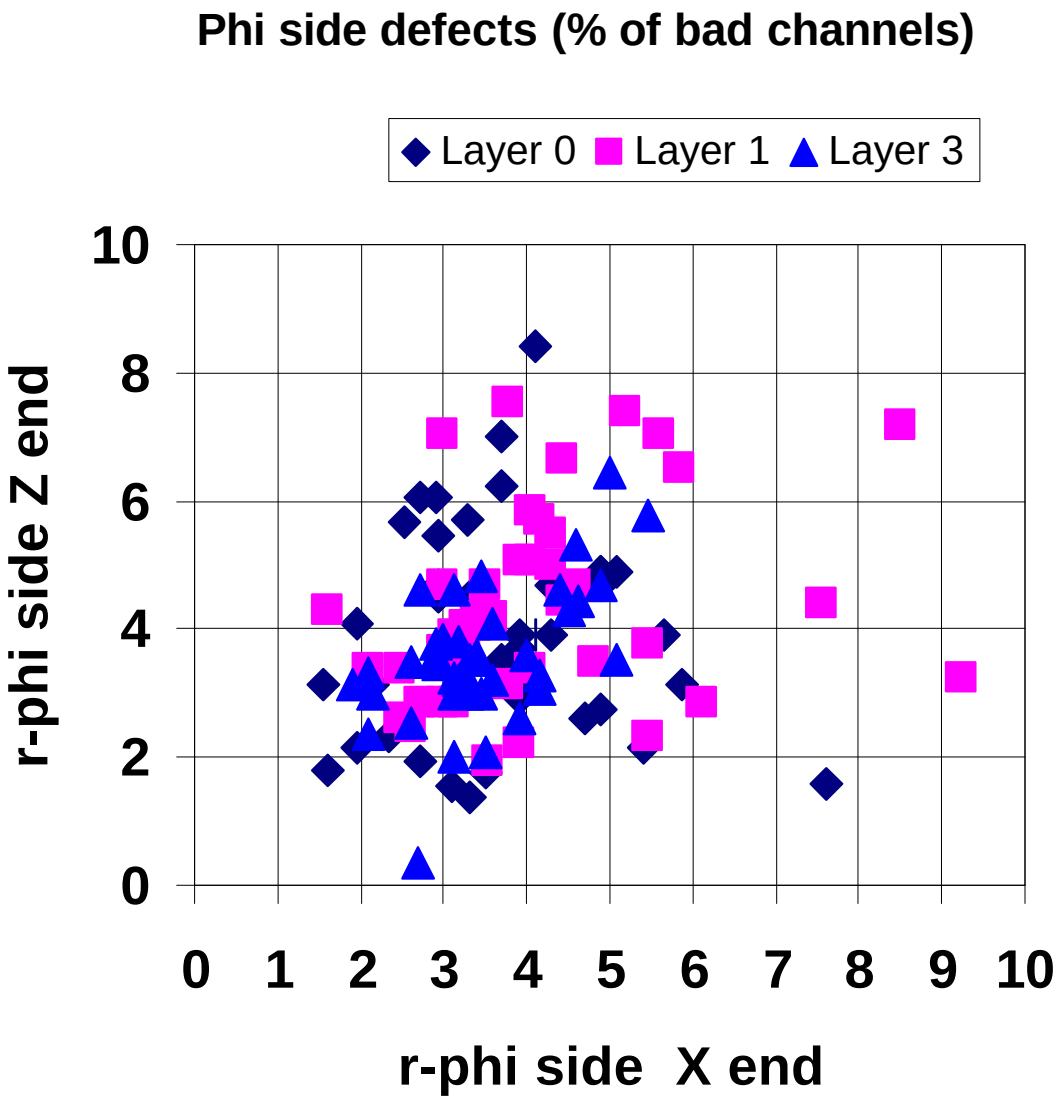


Quarter and Full ladder assembly totals

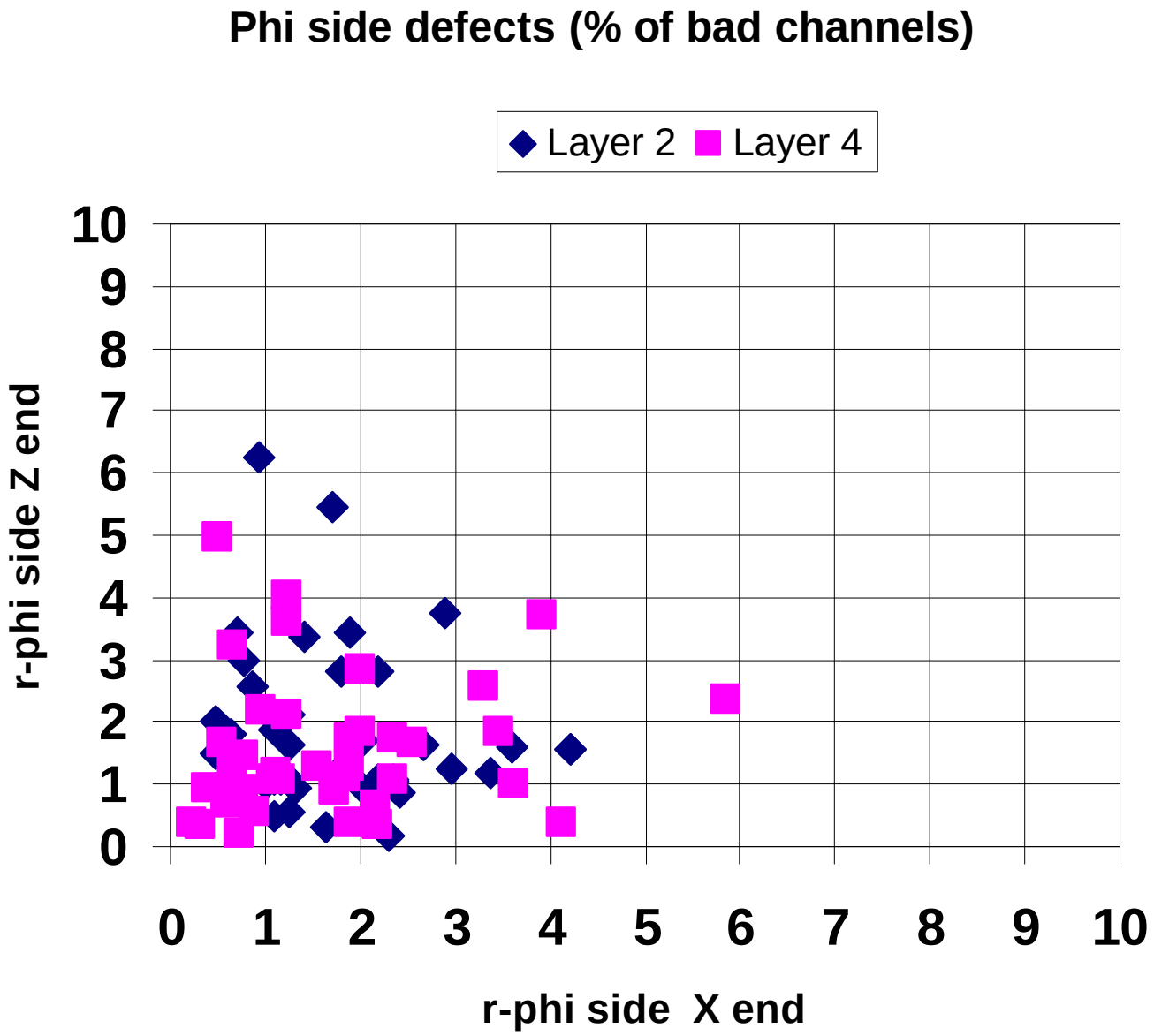
1/4 ladders	Layer 0	Layer 1	Layer 2	Layer 3	Layer 4
prototyping	**23**	**12**	**8**	**14**	**7**
Production Starts	**95**	**95**	**87**	**85**	**91**
Damaged	**10**	**10**	**4**	**3**	**6**
good	**85**	**85**	**83**	**82**	**85**
in Barrels	**72**	**72**	**72**	**72**	**72**
Spares	**13**	**10**	**4**	**3**	**6**

Full Ladders	Layer 0	Layer 1	Layer 2	Layer 3	Layer 4
prototyping	**3**	**3**	**2**	**2**	**2**
Production Starts	**42**	**43**	**42**	**41**	**43**
Damaged	**2**	**2**	**1**	**2**	**5**
good	**40**	**41**	**41**	**39**	**38**
in Barrels	**36**	**36**	**36**	**36**	**36**
Spares	**4**	**5**	**5**	**3**	**2**

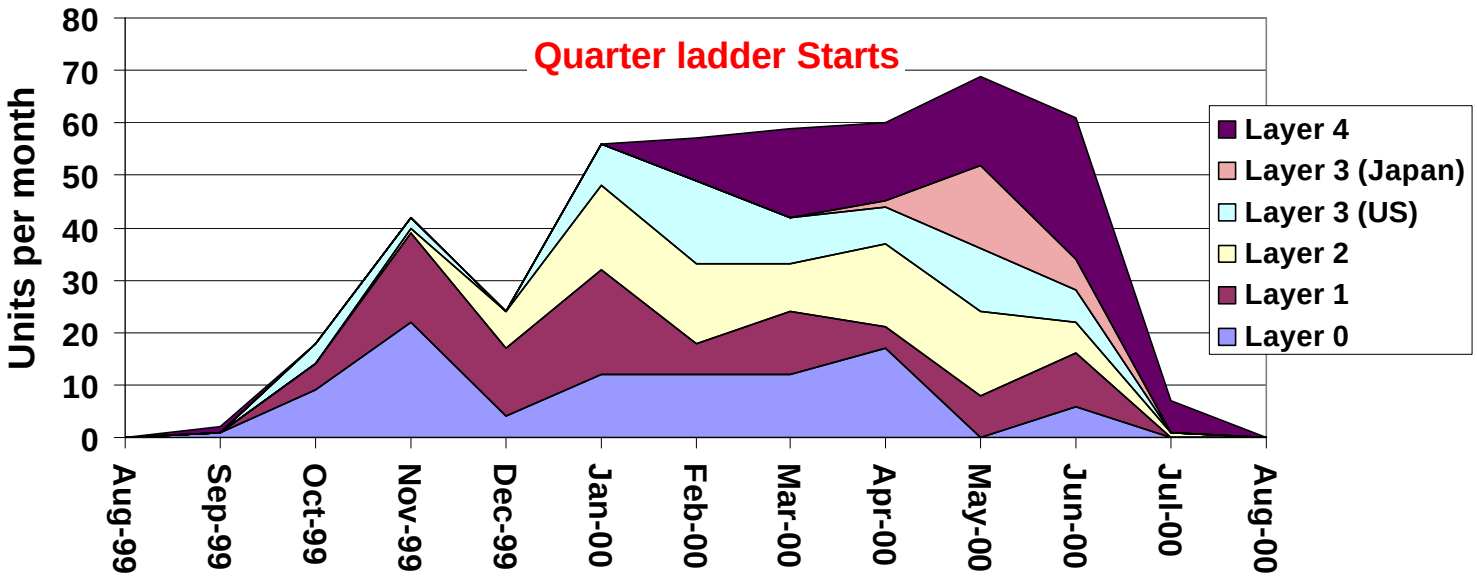
Bad Channel % Ladders with Hamamatsu sensors

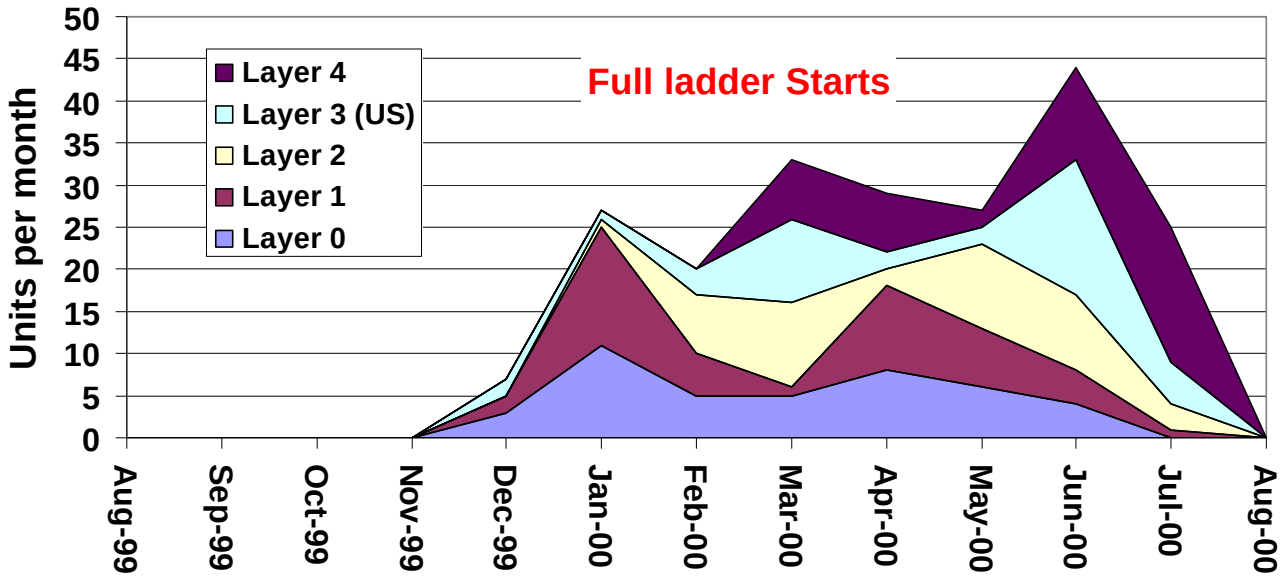


Bad Channel % Ladders with Micron sensors

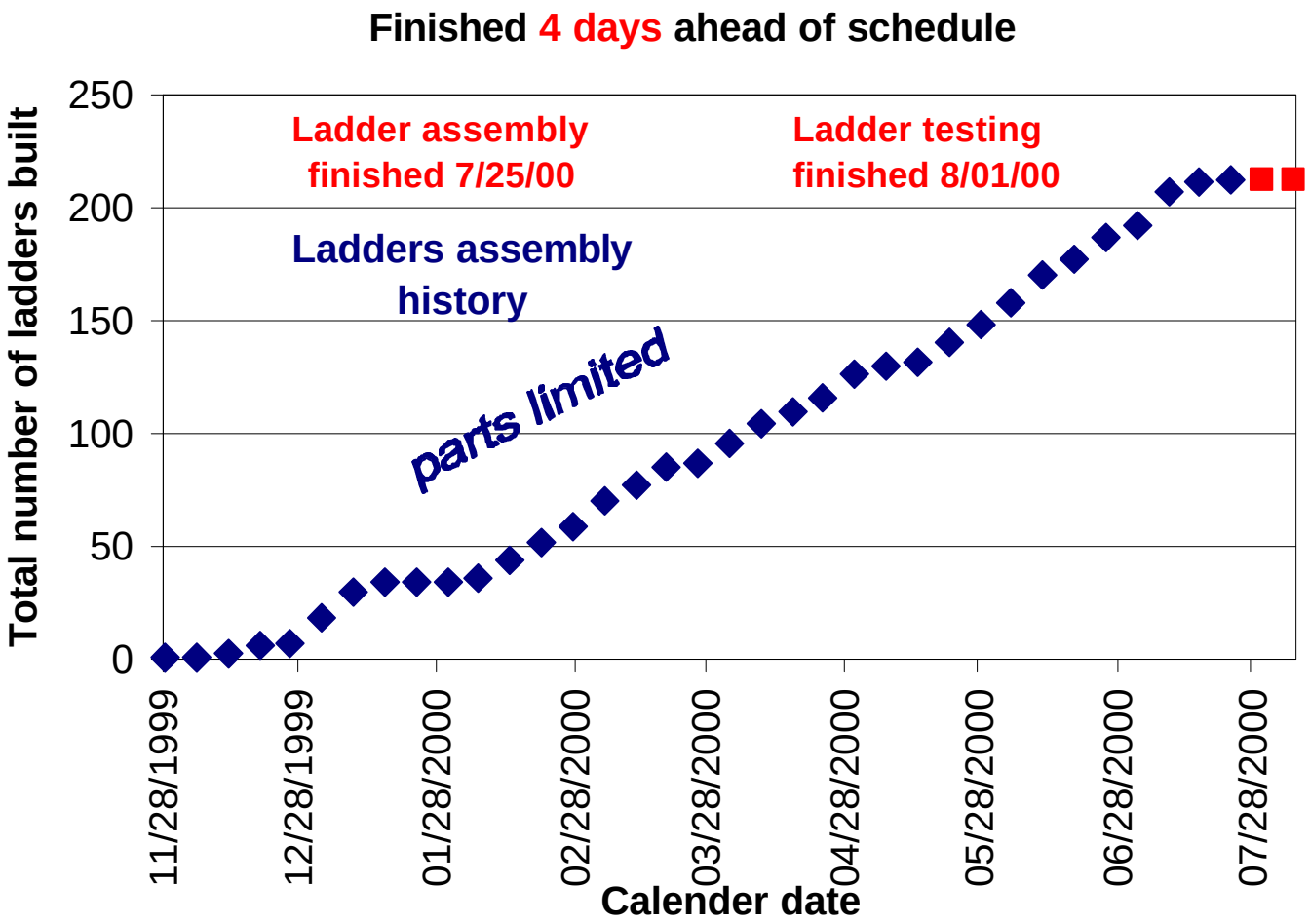


SVX II Ladder production





SVX-II Full ladder Assembly Rate



Conclusions

- SVX II was an exciting and challenging project
- Duke had crucial roles in this upgrade
- Will bring our expertise developed during the construction SVX-II to the off-line work on the silicon tracker (L00, SVX-II and ISL) during run 2a
- Will contribute significantly to run 2b silicon track
- Augments the existing Duke work on other CDF tracking detectors (COT)

Run 2a Silicon activities at Duke

- Maintain control and monitoring of silicon power supply systems (w/ Rochester)
- Implement silicon tracker in new simulation framework
  - Study charge deposition models
  - Tune simulation with data when possible
- Validation of silicon detector simulation
  - track efficiency studies for various environments (b-jets,c-jets,light quark jets)
  - Determine where inefficiencies arise
- Validation of silicon detector tracking
  - Using data processed with production program
  - Could be extended to online study of silicon data quality

Run 2a Silicon activities at Duke (cont.)

- Eventually use expertise to understand heavy flavor tagging efficiencies
  - ➢ Ties in with our run 2 physics goals:

    Higgs, top studies and new physics
- This work will be extended to help in the design considerations for run 2b silicon tracker (more – Mark Kruse's talk)
- 3 people will work on this
  - ➢ Doug Benjamin (½ FTE)

    (DB in discussions with CDF Operations group about being an operations manager for run2a)
  - ➢ Mark Kruse (½ FTE)
  - ➢ New PostDoc (1 FTE)